

***Cribraria lepida*, *Physarum dictyosporum*, *P. diderma*, and *P. spectabile* newly recorded from Turkey**

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ABSTRACT—The moist chamber technique was used to obtain *Cribraria lepida*, *Physarum dictyosporum*, and *P. diderma* from wood or bark at different outdoor localities in Karaman Province and *P. spectabile* in Konya Province. These taxa are reported for the first time from Turkey.

KEY WORDS—*Cribrariaceae*, *Mycetozoa*, myxobiota, *Physaraceae*, slime moulds

Introduction

The myxomycetes, or slime moulds (*Mycetozoa* or *Myxogastria*), are a group of ameboid protists, traditionally studied by mycologists. Martin & Alexopoulos (1969) considered the myxomycetes to represent fungi, but at various times they have been classified as animals, plants, or fungi (Ing 1994). Recently, Cavalier-Smith (2013), following zoological nomenclature, proposed a new classification of the myxomycetes based on evolutionary and phylogenetic evidence; myxomycetes are currently classified as *Myxogastria* in the super-class *Amoebozoa* and first rank *Eumycetozoa*. Fruiting bodies produced by ameboid organisms are referred to as either sporocarps, developing from a single ameboid cell (myxomycetes and protostelids), or sorocarps, developing from an aggregate of ameboid cells (dictyostelids) (Adl & al. 2005). Myxomycetes form a monophyletic group within the *Amoebozoa* (Adl & al. 2018, Leontyev & al. 2019). Despite formal classification as *Amoebozoa*, myxomycetes will continue to be studied by mycologists, while

species classification will likely continue to follow the International Code of Botanical Nomenclature due to the practicality of retaining the system and difficulty in transitioning to another nomenclatural system (Keller & Everhart 2010). In this study, www.eumycetozoa.com was used to determine the nomenclatural status of the genera and www.mycobank.org was used for systematic information.

Myxomycetes are free-living predators of other eukaryotic protists and bacteria and have been recorded in every terrestrial habitat investigated to date (Stephenson & Rojas 2017). In addition to their abundance in the soil, they are abundant and more commonly studied in the overlying litter layer, decaying wood, the bark of living trees, or numerous other substrates associated with various decaying plant materials (Stephenson 2011, Walker & al 2019). Specimens for study can be obtained as fruiting bodies that have developed in the field under natural conditions or cultured in the laboratory (Stephenson & Rojas 2017).

Myxomycete research in Turkey is relatively recent. The first study of myxomycetes in Turkey was made by Lohwag (1957). Recently, interest in these extraordinary organisms has increased in Turkey and a total of 286 myxomycete species have been listed from Turkey (Baba & Sevindik 2019). This report covers Turkish records of four additional myxomycete species.

Materials & methods

During 2013–2018 field surveys were organized for two different projects in Karaman. The moisture chamber technique, applied to collected samples in the cultivated mushroom cultivation room, revealed three new records. A fourth new record was recovered from *Pleurotus ostreatus* culture logs (Hadim-Konya) on which different procedures were performed at the Fungarium of the S.U. Mushroom Application and Research Center. The physical conditions in the mushroom cultivation rooms are close to the moist chamber culture technique; temperature, humidity, and ventilation are automatically controlled as described by Eroğlu & al. (2019): 85–90% humidity; 17–22 °C temperature; 12 hours day and 12 hours night; 10 minutes per hour ventilation; and water vapor fogging for 5 seconds every half hour was automatic in the production room for *Pleurotus* cultivation on poplar logs. Myxomycete development requires higher temperatures (24–25 °C), but the other conditions are suitable.

Materials were examined under the stereo microscope daily and the developing samples were glued to cardboard with their substrates and left to dry in the laboratory. The specimens obtained were dried in the mycology laboratory and identified by myxomycete identification literature (e.g., Martin & Alexopoulos 1969, Neubert & al. 1993). Fungarium numbers were assigned after identification

and illustration of each specimen. During the identification procedure, samples were photographed with an imaging stereo microscope (SM) and a light microscope (LM). The specimens are deposited in the Mushroom Application and Research Center Fungarium, Selçuk University, Konya, Turkey (KONF).

Taxonomy

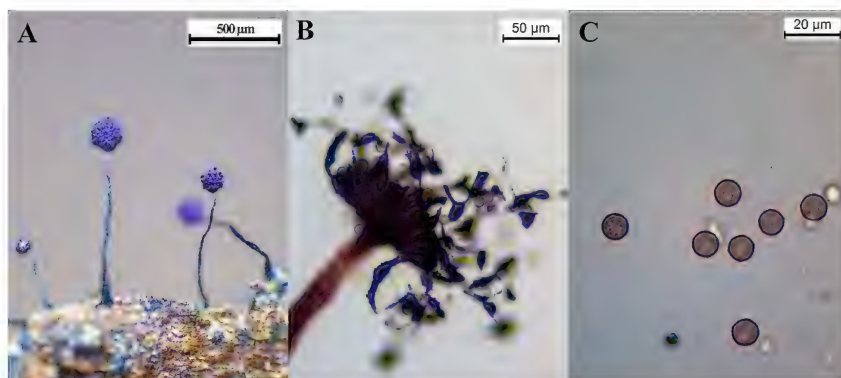


FIG. 1. *Cribraria lepida* (KONF GE141).

A. Sporocarps (SM); B. Peridial meshes and spores (LM); C. Spores (LM).

Cribraria lepida Meyl., Bull. Soc. Vaud. Sci. Nat. 56: 326. 1927.

FIG. 1

Sporocarps gregarious, stalked. Sporotheca nodding, bright violet, 0.25–0.5 mm diam. Stalk dark violet, 2–5 mm long, 6–10 times the diameter of the sporocarp. Calyculus occupying one-third of the zoothecia, net bearing, prominent, thickened, pulvinate nodes. Dictydine granules deep purple, 0.5–1 µm. Spores minutely warted, violet in mass, pale lilaceous by light microscope, (5–)7–8 µm diam.

SPECIMENS EXAMINED: TURKEY. KARAMAN PROVINCE: Sarıveliler, Civler village, 36.6680°N 32.5830°E, 1380 m, on debris wood of *Pinus* sp., 14.11.2015 (KONF GE141); Dumlugöze, 36.5583°N 32.6017°E, 880 m, on debris wood of *Pinus* sp., 01.07.2016 (KONF GE291); Başyayla, 36.7611°N 32.6694°E, 1594 m, 15.10.2016 (KONF GE403).

COMMENTS—*Cribraria lepida*, which can have a color similar to that of *C. violacea* Rex, can be distinguished by the thickened nodes of the peridial reticulum. *C. purpurea* Schrad. has longer sporangia with a relatively short stalk and the dark violet granules are 2–3 (–5) µm diam. (Nannenga-Bremekamp 1991). *C. violacea* has angular, very large nodes. The nodes differ considerably: flattened in *C. violacea* and pulvinate in *C. lepida* (Ramírez-Ortega & al. 2017). *Cribraria lepida* has very long sporangial stalk and is

violet colored while *C. purpurea* is reddish violet or violaceous pink and has a shorter stalk.

Cribraria lepida has been reported from Europe, North and South America, and Asia [Vietnam, Philippines, Western Siberia] (Bernardo & al. 2018, Estrada-Torres & al. 2009, Lado & al. 2011, Martin & Alexopoulos 1969, Meylan 1927, Neubert & al. 1993, Novozhilov & al. 2017, Redefia-Sontos & al. 2018, Vlasenko 2015); here it is reported for the first time from Turkey.

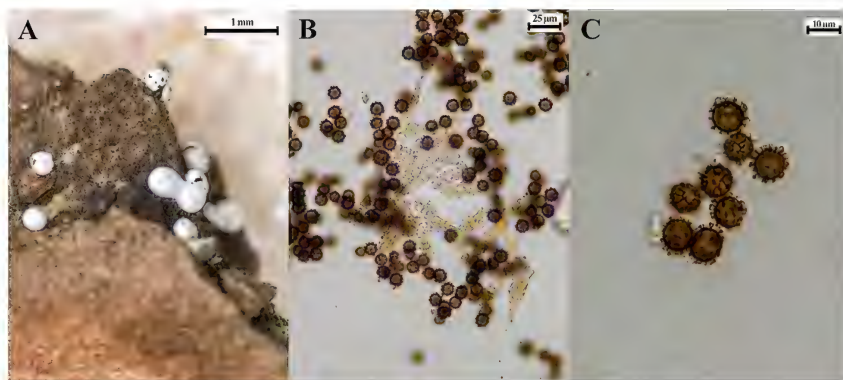


FIG. 2. *Physarum dictyosporum* (KONF GE102).

A. Sporocarps (SM); B. Capillitium and spores (LM); C. Spores (LM).

Physarum dictyosporum G.W. Martin, Brittonia 14: 183. 1962.

FIG. 2

Fructification plasmodiocarpous, scattered with rounded and sessile sporangia, gregarious, 0.4–0.6 mm diam., 0.5–0.6 mm tall, the plasmodiocarps ≤ 2.2 mm long, sinuous, very rarely branched, on inconspicuous dark brown hypothallus. Peridium double, the outer layer a limy crust, white, the inner peridium membranous, translucent, irregularly dehiscent. Capillitium abundant, the nodes white, angular and irregular in shape, connected by inconspicuous threads. Spores black in mass, violaceous brown in transmitted light, globose, 10–15 μm (mostly 10–11 μm) diam., the surface markings banded reticulate, with tall coarse dark warts connected by stout bands. Plasmodium white.

SPECIMENS EXAMINED: TURKEY. KARAMAN PROVINCE: Bucakkışla, 36.9233°N 33.0278°E, 956 m, on bark of living *Pinus* sp., 06.06.2014 (KONF GE102); Taşkale, 37.1344°N 33.6072°E, 1378 m, on bark of living *Fuglans* sp., 09.11.2014 (KONF GE305).

COMMENTS—*Physarum echinosporum* Lister also produces white plasmodiocarpous sporocarps which, however, are laterally compressed, and

not terete as those of *P. dictyosporum* (Liu & al. 2013). *Physarum dictyosporum* has very distinctive spores but superficially resembles the cosmopolitan *Didymium difforme* (Pers.) Gray (Ing & Hnatiuk 1981).

Physarum dictyosporum has been reported from North and Central America, Africa [Seychelles], and Asia [India, Taiwan] (Alexopoulos & Sáenz 1975, Farr 1976, Ing & Hnatiuk 1981, Liu & al. 2013, Ranade & al. 2012, Rojas & al. 2018); here it is reported for the first time from Turkey.

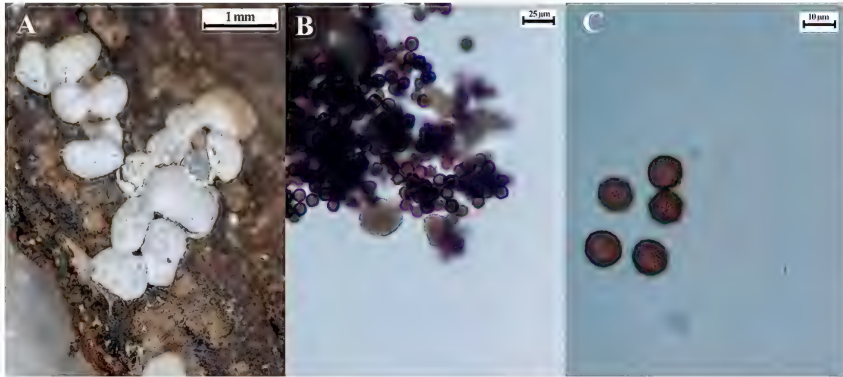


FIG. 3. *Physarum diderma* (KONF GE86).

A. Sporocarps (SM); B. Capillitium and spores (LM); C. Spores (LM).

Physarum diderma Rostaf., Śluzowce Monogr.: 110. 1875 ["1874"].

FIG. 3

Sporangia clustered, sessile or narrowly adnate, globose, pulvinate, about 1 mm. diam., snow-white. Peridium double, the outer layer dense, fragile, thick, calcareous, the inner delicate, translucent, membranous. Capillitium abundant, the nodes white, angular, sometimes uniting to form a pseudocolumella. Spores black in mass, purplish-brown in transmitted light, rough, 10–12 µm diam.

SPECIMENS EXAMINED: TURKEY. KARAMAN PROVINCE: Kazımkarabekir, 37.205°N 32.9469°E, 1154 m, on bark of living *Quercus* sp., 17.05.2013 (KONF GE12); Bucakkışla, near Göksu river, 36.9508°N 33.0203°E, 421 m, on debris wood of *Pinus* sp., 06.06.2014 (KONF GE86).

COMMENTS—*Physarum diderma* can be confused with *P. didermoides* (Pers.) Rostaf., *P. spectabile*, and *P. bitectum* G. Lister. The sporocarps of *P. didermoides* are sessile or stalked; when membranous stalked, the stalk often appears like a flattened extension of the hypothallus. *Physarum bitectum* sporocarps are slightly compressed laterally contrasting with the sessile globose sporocarps

of *P. diderma*. The capillitia of *P. didermoides* and *P. licheniforme* (Szabó ex Schwein.) Lado are small and rounded, in contrast to the large angular capillitium in *P. diderma* (Poulain & al. 2011).

Physarum diderma has been reported from Europe, North America, and Asia [Israel, India] (Eliasson & Adamonyte 2009, Harling 1952, Martin 1949, Novozhilov & al. 2006, Ukkola & al. 1996, Zoll & Stephenson 2015); here it is reported for the first time from Turkey.

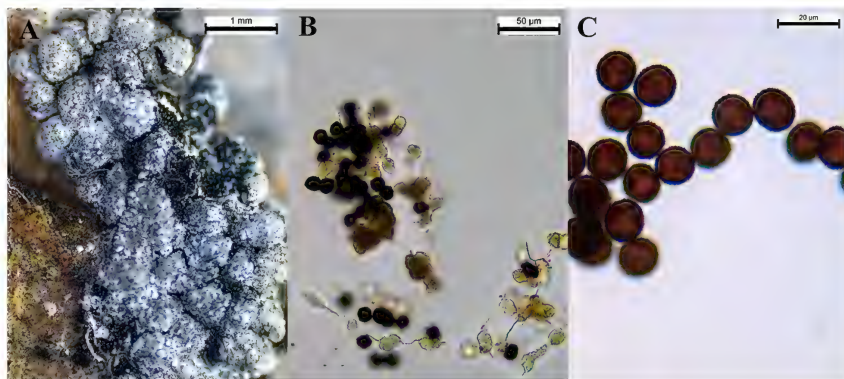


FIG. 4. *Physarum spectabile* (KONF GE747).

A. Sporocarps (SM); B. Capillitium and spores (LM); C: Spores (LM).

Physarum spectabile Nann.-Bremen., Lado & G. Moreno,

Proc. K. Ned. Akad. Wet., Ser. C, Biol. Med. Sci. 87(1): 91. 1984.

FIG. 4

Sporangia sessile; crowded or scattered, sometimes heaped; flattened, pulvinate, on wide base; sporangia 0.5–0.7 mm diam., plasmodiocarps 1–2.5 × 0.5–0.7 mm, white. Peridium single, membranous, white or ash-gray, encrusted with granular white lime in upper part. Hypothallus membranous, translucent, inconspicuous. Stalk and columella absent. Capillitium comprising a small-meshed net of colorless fine tubes with many rounded, (sometimes oblong and branched) lime nodes, sometimes forming pseudocolumella. Spores dark brown or almost black in mass; dark purplish brown in transmitted light, angular in optical section, with pale narrow lines, 12–14 µm diam., densely ornamented regularly distributed warts.

SPECIMEN EXAMINED: TURKEY. KONYA PROVINCE: Hadim, Eğiste stream, 35.1083°N 32.4558°E, 1081 m, on bark of *Populus* sp. culture log of *Pleurotus ostreatus*, 18.10.2017 (KONF GE747); Eğiste stream, 37.10944°N 32.4575°E, 1095 m, on bark of *Populus* sp. culture log of *P. ostreatus*, 18.10.2017 (KONF GE755).

COMMENTS—*Physarum spectabile* has very variable characters and may be either sessile or have a well-defined calcareous stalk. The species can be confused with *P. straminipes* Lister, which has a non-calcareous membranous extension of the hypothallus and not a stalk. Even when *P. spectabile* is sessile, the narrow pale bands on the usually angular spore separate *P. straminipes* from *P. atacamense* D. Wrigley & al. and *Badhamia melanospora* Speg. (Nannenga-Bremekamp & al. 1984, Lado & al. 2007, Estrada-Torres & al. 2009, Wrigley de Basanta & al. 2012, Gmoshinskiy & al. 2017). *Badhamia melanospora* has a completely different badhamioid capillitium with calcareous tubes in a network, not limeless tubes connecting small round lime nodes (Castillo & al. 1996, Moreno & Oltra 2010, Gmoshinskiy & al. 2017).

Physarum spectabile has been reported from Europe, North and South America, and Africa (Estrada-Torres & al. 2009, Gmoshinskiy & al. 2017, Kylin & al. 2013, Lado & al. 2007, Lizárraga & al. 2015, Nannenga-Bremekamp & al. 1984, Ndiritu & al. 2009, Oltra & Tejedor 2005, Xavier de Lima & Cavalcanti 2017, Yatsiuk & al. 2017); here it is reported for the first time from Turkey and from Asia.

Discussion

Cribraria was proposed by Persoon (1794); and *Cribraria* species are characterized by dictydine granules, peridium remaining as a net with without nodes, and sporangiate fruiting bodies consisting of stalked sporangia with or without basal cups (Liu & Chang 2007). According to Martin (1949), Martin & Alexopoulos (1969), and Nannenga-Bremekamp (1991), plasmodic granules, the lack of a capillitium, and the persistent surface net make *Cribraria* species easy to recognize (Ramírez-Ortega & al. 2009). The plasmodic granules of *Cribraria* are also referred to as dictydine granules (Martin & Alexopoulos 1969, Keller & Braun 1999, Stephenson 2003), calcareous dictydine granules (Ing 1999), lime globules (Nannenga-Bremekamp 1991) or calcic granules (Discover Life 2020).

Physarum was also proposed by Persoon (1794). The name was coined based on the bubble-like appearance of the sporangium (Ranade & Ranadive 2016). The single most important character in *Physarum* is the presence of lime (calcium carbonate) deposits that may occur in the peridium, capillitium, or sporothecal stalk (Stephenson & Stempen 2000). With about 149 taxa worldwide, *Physarum* is the largest myxomycete genus (Lado 2020) and the most widely known genus among the myxomycetes (Hoppe & al. 2010).

According to the literature, myxomycetes have been reported as a weak disease on fungi growing on culture stumps (Chung & al. 1998, Lee & al. 2014). However, according to these authors, myxomycetes are not pathogenic, rather consuming mushroom hyphae and spores as food. Although there are studies on myxomycetes developing on cultures elsewhere (Chung & al. 1998, Desrumaux & al. 2003), none were detected in Turkey. Although *Physarum spectabile* generally commonly occurs on cacti and succulent plants (Nannenga-Bremekamp & al. 1984), the species is reported here for the first time on mushroom culture logs.

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